

LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA16 | Ladbroke and Southam

Data appendix (AG-001-016)

Agriculture, forestry and soils

November 2013

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Department
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Appendix AG-001-016

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1 Introduction

1.1.1 The agriculture, forestry and soils appendices for the Ladbroke and Southam community forum area (CFA16) comprise:

- Soils and agricultural land classification surveys (Section 2);
- Forestry (Section 3); and
- Farm impact assessment summaries (Section 4).

1.1.2 Maps referred to throughout the agriculture, forestry and soils appendix are contained in the Volume 5 agriculture, forestry and soils map book.

2 Soils and agricultural land classification surveys

2.1 Background

- 2.1.1 The soils and agricultural baseline conditions reported have been established from desktop studies and site surveys.
- 2.1.2 Information gathered by desktop studies has related primarily to the identification of soil resources in the study area, the associated physical characteristics of geology, topography and climate which underpin the assessment of agricultural land quality, and the disposition of land uses. The main sources of information have included:
- National Soil Map¹;
 - Soils and Their Use in Midland and Western England²;
 - Soils in Warwickshire³;
 - Solid and superficial deposits from the Geology of Britain viewer⁴;
 - Gridpoint meteorological data for Agricultural Land Classification of England and Wales⁵;
 - Provisional Agricultural Land Classification of England and Wales (1:250,000)⁶;
 - Likelihood of Best and Most Versatile Agricultural Land (1:250,000)⁷;
 - Agri-environment schemes⁸;
 - Aerial photography from Google Earth; and
 - On-site soil and Agricultural Land Classification surveys.
- 2.1.3 Information gathered by field survey⁹ has related to the enhancement of desk-based information on soils and agricultural land quality, and the engagement with landowners and tenants to establish the nature and extent of agricultural, forestry and related rural enterprises.
- 2.1.4 Field and other data were interpreted using the MAFF's 1988 Revised Guidelines and Criteria for Grading the Quality of Agricultural Land¹⁰.

¹ Cranfield University (2001), *The National Soil Map of England and Wales 1:250,000 scale*. Cranfield University: National Soil Resources Institute.

² Soil Survey of England and Wales (1984), *Soils and Their Use in Midland and Western England*. Harpenden.

³ Whitfield, William (1974), *Soils in Warwickshire I; SP36 (Leamington Spa)*. Rothamsted Experimental Station.

⁴ British Geological Survey. <http://bgs.ac.uk/geologyofbritain/home/html>.

⁵ Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations*.

⁶ Ministry of Agriculture, Fisheries and Food (1983), *Agricultural Land Classification of England and Wales (1:250,000)*.

⁷ Department for Environment, Food and Rural Affairs (2005), *Likelihood of Best and Most Versatile Agricultural Land (1:250,000)*.

⁸ Multi-Agency Geographical Information for the Countryside (MAGIC) available online www.magic.gov.uk.

⁹ Hodgson, J.M. (1997), *The Soil Survey Field Handbook*. Soil Survey Technical Monograph no. 5, Silsoe.

¹⁰ Ministry of Agriculture, Fisheries and Food (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land*.

- 2.1.5 Information obtained from farm impact assessment interview surveys has been taken as a factual representation of local agricultural and forestry interests and has not been subject to further evaluation.

2.2 Soils and land resources

- 2.2.1 This part of the technical appendix describes the findings of a desktop study and targeted soil survey and Agricultural Land Classification (ALC) survey that identified existing soil and agricultural land resources in the study area.

- 2.2.2 The location and extent of different soil types and agricultural land in the different ALC grades are influenced by topography and drainage, and by geology and soil parent materials, which are described in turn in the following sections. This section then provides a description and distribution of the main soil types encountered along the study corridor.

Topography and drainage

- 2.2.3 The local area has a gently undulating landscape of low hill tops and clay vales. The route passes over the Warwickshire/Northamptonshire boundary, near Wormleighton, cutting through a ridge where the landscape along the line of the route is at its greatest elevation of 140m above Ordnance Datum (AOD). The land then falls to a broad vale occupied by a pair of tributary valleys of the River Itchen in Radbourn parish at 100m AOD, and then rises to Windmill Hill in Ladbroke at 120m AOD. To the south of Southam the land gently undulates between 75m and 100m AOD and then rises to 110m AOD on the broadly north-west facing escarpment that passes from Ufton Wood through Long Itchington Wood to Bascote. North-west of the escarpment slope the land descends gradually to the Grand Union Canal at 65m AOD.
- 2.2.4 Draining the broad clay vale between Wormleighton and Windmill Hill a pair of small tributary streams flows to the River Itchen, which takes a northerly route to join the River Leam at Marton. The Oxford Canal follows the contours at about 115m AOD through Wormleighton and Stoneton parishes and joins the Grand Union Canal at Napton.

Geology and soil parent materials

- 2.2.5 The main geological features are described in detail in Section 8. Superficial deposits underlying the Proposed Scheme in the Ladbroke and Southam area are largely confined to Alluvium (clay, silt, sand and gravel) in river valleys. Head deposits consisting of sand and gravel with lenses of silt and clay are present to the north-west of Long Itchington and Ufton Woods. A small area of clayey glacial deposits lies to the south of Long Itchington Wood.
- 2.2.6 Mudstone and occasional limestone of the Charmouth Mudstone Formation are present from the south of the Proposed Scheme to the south of Southam. The Rugby Limestone Member (interbedded mudstones and limestones) and the Saltford Shale Member (mudstone), both of the Blue Lias Formation, are present to the south and south-west of Southam. Northwards from the valley formed by the River Itchen, the bedrock comprises the Penarth Group (interbedded argillaceous rock and limestone) including the Langport Member (limestone) as far as the northern extent of Long

Itchington and Ufton Woods. Bedrock from the north of Long Itchington and Ufton Woods to the north of the Proposed Scheme comprises the Mercia Mudstone Group, including the Arden Sandstone Formation sub-unit and dolomitic siltstones.

- 2.2.7 A list of geological strata occurring within the study area is provided in age order in Table 1 and shown on Map WR-02-016 (Volume 5).

Table 1: Bedrock and soil forming materials

| Formation | Composition/soil parent material |
|-----------------------------|--|
| Superficial deposits | |
| Alluvium | Clay, silt, sand and gravel |
| Head | Clay, silt, sand and gravel |
| Glaciofluvial Deposits | Devensian sand and gravel |
| Glaciolacustrine Deposits | Clay and silt |
| Bedrock | |
| Charmouth Formation | Predominantly mudstone with occasional limestone |
| Rugby Limestone Member | Interbedded mudstones and limestone |
| Saltford Shale Member | Mudstone |
| Langport Member | Limestone |
| Penarth Group | Interbedded argillaceous rock and limestone |
| Mercia Mudstone Group | Mudstone and sandstone |

Description and distribution of soil types

- 2.2.8 The characteristics of the soils are described by the Soil Survey of England and Wales that accompanies the National Soil Map. The soils are grouped into soil associations of a range of soil types (soil series) and are summarised in Table 2, and their distribution is shown on Map AG-02-16.

Table 2: Soil associations

| Soil association: code shown on Map AG-02-16 | Soil association: name | Description | Wetness class |
|--|------------------------|---|---------------|
| 411a and 411b ¹¹ | Evesham 1 and 2 | Slowly permeable, seasonally waterlogged calcareous clay or heavy clay loam over clay soils, frequently with limestone bands in the subsoil. | II-III |
| 431 | Worcester | Slowly permeable seasonally waterlogged reddish clay or heavy clay loam over slowly permeable clay and mudstone. | III |
| 712b | Denchworth | Slowly permeable seasonally waterlogged clay soils, and some similar soils with heavy clay loam topsoils. Waterlogged for long periods in winter. | III-IV |
| 813b | Fladbury | Stoneless clayey soils, waterlogged for long periods in winter | III-IV |

¹¹ 15ha of Evesham 2 is mapped in the Itchen valley but the soils there were found to be similar to those of the Evesham 1.

2.2.9 The National Soil Map shows four principal soil types within this community forum area:

- in the south-east and centre, between the Warwickshire/Northamptonshire boundary and Southam, and to the north-west of Southam, in and around Long Itchington and Ufton Woods, the soils are of the Denchworth association on largely drift-free Jurassic clays. They have mainly stoneless to slightly stony, heavy clay loam or clay topsoil over clay subsoil which are slowly permeable and waterlogged for long periods in winter and, hence, are most commonly assessed as being of Wetness Class (WC) IV¹²;
- west of Southam there are calcareous clay soils of the Evesham 1 association, often containing limestone fragments. Topsoils are mainly calcareous heavy clay loam or clay and subsoils are calcareous clay. They experience seasonal waterlogging (WC III). A small area (15ha) of the Evesham 2 association is mapped in the Itchen valley, but the soils there were found to be similar to those of the surrounding Evesham 1;
- west of the Long Itchington and Ufton Woods escarpment the soils developed in reddish Mercian Mudstone are of the Worcester association; typically with reddish heavy clay loam or clay topsoils over slowly permeable clay subsoils. They experience seasonal waterlogging (WC III); and
- on the floodplain of the valley occupied by the Grand Union Canal there are alluvial soils of the Fladbury association that are clayey throughout and wet for long periods (WC IV).

2.3 Agricultural land quality

- 2.3.1 A review of available ALC information has been undertaken to ascertain the land quality within the study area. The review also sought to identify the extent of existing detailed post-1988 ALC information to ensure that surveys are not repeated unnecessarily.
- 2.3.2 The ALC assessment is initially based upon the Provisional Agricultural Land Classification (ALC) of England and Wales (1:250,000). Higher confidence levels have been gained from detailed surveys made for industrial developments around Southam that are available from the MAGIC website, and from field surveys carried out specifically for this project.
- 2.3.3 In areas where access to land was not granted to access sites, ALC has been assessed from available information in the form of archived Soil Survey auger bore records obtained from the National Soil Resources Institute at Cranfield University. In areas where land access was not granted and no archived records were available, a professional judgement was made using published soil maps, geological information and interpolation from adjacent recorded bores.

¹² The Wetness Class (WC) of a soil is classified in Appendix II of Hodgson, J.M. (1977), The Soil Survey Field Handbook. Soil Survey and Land Research Centre, Technical Monograph No.5, according to the depth and duration of waterlogging in the soil profile and has six bands ranging from Wetness Class I (well drained) to Wetness Class VI (permanently waterlogged).

Detailed agricultural land classification

- 2.3.4 A total of 52 archived bores were obtained from Cranfield University and 42 new auger bores were made in the vicinity of the routeline. The holdings surveyed in 2012 and 2013 are CFA16/9 (Ladbroke Hill Farm), CFAS16/10 (Grounds Farm), CFA16/11 (Starbold Farm), CFA16/12 (Greenleaf Nursery) and CFA16/14 (Wood Farm).
- 2.3.5 The principal physical factors influencing agricultural production and land quality are climate, site and soil, and the interactions between them.
- 2.3.6 Soil profiles were examined using an Edelman (Dutch) auger and a spade. Where soils were stony or dry a 2.5 cm diameter screw auger was used to enable deeper penetration. At each observation point the following characteristics were assessed for each soil horizon up to a maximum of 120cm where possible, or to any impenetrable layer:
- soil texture;
 - significant stoniness;
 - colour (including local gley and mottle colours);
 - consistency;
 - structural condition;
 - free carbonate; and
 - depth.
- 2.3.7 Soil available water capacity, relevant to the assessment of drought risk, was estimated from texture, structure, organic matter content, stone content and profile depth.

Agro-climatic limitations

- 2.3.8 The local climatic factors have been interpolated from the Meteorological Office's database (Met Office 1989) held in the Landis climatic database at Cranfield University¹³ at 1 km intervals along the line of the track. The average of the parameters is given in Table 3. There is a small variation across the CFA: FCDs are within the range 140 to 157 days; average annual rainfall (AAR) is from 656mm to 704mm; moisture deficits are 96mm to 103mm for wheat and 85mm to 94mm for potatoes.

Table 3: Interpolated agro-climatic data

| Climatic parameter | Warwickshire County Boundary (SP4603 5362) | Windmill Hill (SP4242 5942) | A425 Crossing (SP3984 6182) |
|------------------------------|---|--------------------------------|--------------------------------|
| Altitude (m) | 135 | 88 | 90 |
| Average annual rainfall (mm) | 704 | 657 | 656 |

¹³ <http://archive.defra.gov.uk/foodfarm/landmanage/land-use/documents/alc-guidelines-1988.pdf> Accessed: August 2013.

| Climatic parameter | Warwickshire County Boundary (SP4603 5362) | Windmill Hill (SP4242 5942) | A425 Crossing (SP3984 6182) |
|---|---|--------------------------------|--------------------------------|
| Accumulated Temperature >0°C (Jan-June) | 1340 | 1392 | 1389 |
| Field Capacity Days (days) | 157 | 144 | 140 |
| Average Moisture Deficit, wheat (mm) | 96 | 103 | 103 |
| Average Moisture Deficit, potatoes (mm) | 85 | 94 | 93 |

- 2.3.9 Climate itself does not place any limitation upon the land in this part of the West Midlands, but the interactions of climate with soil characteristics are important in determining the wetness and droughtiness limitations of the soil.
- 2.3.10 The influence of climate on soil wetness is assessed by reference to median Field Capacity Days (FCD) when the soil moisture deficit is zero, soil wetness class (WC) and topsoil texture (MAFF 1988 Table 6). Soil WC was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling and/or poorly permeable subsoil layers at least 15cm thick.
- 2.3.11 The ALC grade according to soil wetness was determined by following the methodology set out in the ALC Guidelines (October 1988) and the information in the Table 4.

Table 4: ALC grade according to soil wetness – mineral soils (based on Table 6 of ALC Guidelines, October 1988)

| Wetness class | Texture ¹ of the top 25 cm | Field capacity days | | | | |
|---------------|---------------------------------------|---------------------|---------|---------|---------|------|
| | | <126 | 126-150 | 151-175 | 176-225 | >225 |
| I | S ² LS ³ SL SZL | 1 | 1 | 1 | 1 | 2 |
| | ZL MZCL MCL SCL | 1 | 1 | 1 | 2 | 3a |
| | HZCL HCL | 2 | 2 | 2 | 3a | 3b |
| | SC ZC C | 3a(2) | 3a(2) | 3a | 3b | 3b |
| II | S ² LS ³ SL SZL | 1 | 1 | 1 | 2 | 3a |
| | ZL MZCL MCL SCL | 2 | 2 | 2 | 3a | 3b |
| | HZCL HCL | 3a(2) | 3a(2) | 3a | 3a | 3b |
| | SC ZC C | 3a(2) | 3b(3a) | 3b | 3b | 3b |
| III | S ² LS SL SZL | 2 | 2 | 2 | 3a | 3b |
| | ZL MZCL MCL SCL | 3a(2) | 3a(2) | 3a | 3a | 3b |
| | HZCL HCL | 3b(3a) | 3b(3a) | 3b | 3b | 4 |
| | SC ZC C | 3b(3a) | 3b(3a) | 3b | 4 | 4 |
| IV | S ² LS SL SZL | 3a | 3a | 3a | 3b | 3b |
| | ZL MZCL MCL SCL | 3b | 3b | 3b | 3b | 3b |
| | HZCL HCL | 3b | 3b | 3b | 4 | 4 |
| | SC ZC C | 3b | 3b | 3b | 4 | 5 |
| V | S LS SL SZL | 4 | 4 | 4 | 4 | 4 |

| Wetness class | Texture ¹ of the top 25 cm | Field capacity days | | | | |
|---------------|---------------------------------------|---------------------|---------|---------|---------|------|
| | | <126 | 126-150 | 151-175 | 176-225 | >225 |
| | ZL MZCL MCL SCL | 4 | 4 | 4 | 4 | 4 |
| | HZCL HCL | 4 | 4 | 4 | 4 | 4 |
| | SC ZC C | 4 | 4 | 4 | 5 | 5 |

Soils in Wetness Class VI – Grade 5

Texture key: S – sand; LS – loamy sand; SL – sandy loam; SZL – sandy silt loam; ZL – silt loam; MZCL – medium silty clay loam; MCL – medium clay loam; SCL – sandy clay loam; HZCL – heavy silty clay loam; HCL – heavy clay loam; SC – sandy clay; ZC – silty clay; C – clay

¹ For naturally calcareous soils with more than 1% CaCO₃ and between 18% and 50% clay in the top 25 cm, the grade, where different from that of other soils, is shown in brackets

² Sand is not eligible for Grades 1, 2 or 3a

³ Loamy sand is not eligible for Grade 1

- 2.3.12 Droughtiness is determined by comparing crop-adjusted available water (AP), with the moisture deficit (MD) for the locality for wheat and potatoes (MAFF 1988 Appendix 4). Grading of the land can be affected if the AP is insufficient to balance the MD and droughtiness occurs. The availability of irrigation can improve grading by 1 division where appropriate. However, irrigation is not common practice for grass cereals and oil seed rape (OSR). The calculation used in the ALC Guidelines (October, 1988)¹⁰ to determine the severity of this limitation is given below in Figure 1.

Site limitations

- 2.3.13 The assessment of site limitations is primarily concerned with the way in which topography influences the use of agricultural machinery and hence the cropping potential of land. Gradient and microrelief¹⁴ are not considered limiting in this CFA. Flooding is restricted to the floodplains of the River Itchen and its tributaries. However, no agricultural land within the study area is limited, in terms of its agricultural potential, by the frequency and/or duration of annual flooding during the summer or the winter.

Soil limitations

- 2.3.14 The main soil properties which affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility. Together they influence the functions of soil and affect the water availability for crops and soil drainage, workability and trafficability. The main limiting soil characteristics within the CFA are the heavy clay loam and clay topsoils combined with waterlogging of the slowly permeable mudstone-derived subsoils.

¹⁴ Complex changes of slope angle and direction over short distances or the presence of boulders or rock outcrops, even on level or gentle slopes, which can severely limit the use of agricultural machinery.

Figure 1: Methodology for calculating the severity of a droughtiness limitation to ALC grading (derived from MAFF, 1988)

$$AP \text{ wheat (mm)} = \frac{TA_{vt} \times LT_t + \sum (TA_{vs} \times LT_{50}) + \sum (EA_{vs} \times LT_{50-120})}{10}$$

where

TA_{vt} is Total available water (TA_v) for the topsoil texture

TA_{vs} is Total available water (TA_v) for each subsoil layer

EA_{vs} is Easily available water (EA_v) for each subsoil layer

LT_t is thickness (cm) of topsoil layer

LT_{50} is thickness (cm) of each subsoil layer to 50 cm depth

LT_{50-120} is thickness (cm) of each subsoil layer between 50 and 120 cm depth

Σ means 'sum of'.

$$AP \text{ potatoes (mm)} = \frac{TA_{vt} \times LT_t + \sum (TA_{vs} \times LT_{70})}{10}$$

where

LT_{70} is thickness (cm) of each subsoil layer to 70 cm depth

MB (Wheat) = AP (Wheat) - MD (Wheat)

MB (Potatoes) = AP (Potatoes) - MD (Potatoes)

Where

MB is the Moisture Balance

AP is the Crop-adjusted available water capacity

MD is the moisture deficit, as determined by the agro-climatic assessment.

Table 8 Grade according to droughtiness

| Grade/ Subgrade | Moisture Balance limits (mm) | | |
|--------------------|------------------------------|------------|-----------------|
| | <i>wheat</i> | | <i>potatoes</i> |
| 1 | +30 | <i>and</i> | +10 |
| 2 | +5 | <i>and</i> | -10 |
| 3a | -20 | <i>and</i> | -30 |
| 3b | -50 | <i>and</i> | -55 |
| 4 | <-50 | <i>or</i> | <-55 |

Interactive limitations

- 2.3.15 The principal limiting factors determining agricultural land quality in this study area are soil wetness and soil droughtiness. Overall, the assessment of agricultural land quality in the study area indicates that there is a high proportion (87%) of agricultural land of moderate quality, Subgrade 3b, with the remainder as Subgrade 3a.
- 2.3.16 Land within the Denchworth soil association, with non-calcareous clay and clay loam topsoils and a slowly permeable layer typically within 40cm depth or less, is almost entirely Subgrade 3b, whether WC III or IV. Soil wetness accompanied by heavy texture is considered the main limiting factor.
- 2.3.17 Land occupying floodplains (Fladbury soil association) has been assessed as Subgrade 3b because of a soil wetness limitation. A small area of boulder clay (till) south of Long Itchington Wood is also Subgrade 3b based on wetness and heavy texture. At the north-west end of the Ladbroke and Southam study area, slowly permeable soils of the Worcester association are mostly WC III, with wetness and workability limitations. With heavy clay loam topsoils they are mainly classed as Subgrade 3b, although some areas of 3a are identified where medium clay loam topsoils and upper subsoils occur.
- 2.3.18 West of Southam, in clays with calcareous topsoil and limestone in the subsoil (Evesham 1 and 2 soil associations), is an area of Subgrade 3a soils. To be in this grade, the soils are required to have less than 50% topsoil clay (i.e. no heavier than medium clay loams), a WC of II or III and are in a locality where the FCD value is 150 days or less.

Summary of ALC assessment in CFA16

- 2.3.19 The characteristics of the soil series encountered within each association and a summary of the key characteristics relevant to the ALC grading in CFA16 are given in Table 5 to Table 8.

Table 5: 411a and 411b Evesham 1 and 2 associations

Slowly permeable, seasonally waterlogged calcareous clay or heavy clay loam over clay soils, frequently with limestone bands in the subsoil.

| Main soil series | Ancillary soil series occurring locally | Geology | Average field capacity days (max 145 min 140) | Wetness class | Average moisture deficit and average and (available water) mm | | ALC grade | ALC determinants |
|------------------|---|-------------------------------|---|---------------|---|-----------|-----------|---|
| | | | | | Wheat | Potatoes | | |
| Evesham | | Mudstone with limestone bands | 143 | II-III | 104 (>115) | 95 (>100) | 3a | Calcareous clay topsoil and wetness class |
| | Haselor | Limestone with mudstone bands | 143 | II-III | 104 (>105) | 95 (>90) | 3a | Calcareous clay topsoil and wetness class |

Brief Soil Profile Descriptions

| Evesham | Haselor |
|---|--|
| 0-25cm Ap Dark brown, slightly stony clay; calcareous 25-40cm Bw(g) ₁ Olivebrown, stoneless clay; moderate medium subangular blocky structure; calcareous 40-75cm Bw(g) ₂ Light olive brown, slightly mottled, stoneless clay: strong medium angular blocky structure; calcareous 75-120 BC(g) Grey, slightly mottled, stoneless clay: massive structure; calcareous | 0-25cm Ap Dark brown, slightly stony clay; calcareous 25-55cm Bw(g) Olivebrown, mottled, slightly to moderately stony clay; coarse angular blocky structure; calcareous 55-80cm Cr Grey, fine grained limestone bands with interbedded mudstone |

Appendix AG-001-016 | Soils and agricultural land classification surveys

Table 6: Worcester association (431)

Slowly permeable seasonally waterlogged reddish clay or heavy clay loam over slowly permeable clay and mudstone.

| Main soil series | Ancillary soil series occurring locally | Geology | Average field capacity days (max 145 min 140) | Wetness class | Average moisture deficit and average and (available water) mm | | ALC grade | ALC determinants |
|------------------|---|------------------|---|---------------|---|-----------|-----------|---|
| | | | | | Wheat | Potatoes | | |
| Worcester | | Reddish mudstone | 143 | III | 106 (>115) | 98 (>110) | 3b | Heavy clay loam or clay topsoil and wetness class |
| | Whimble | Reddish mudstone | 143 | III | 106 (>115) | 98 (>110) | 3b | Heavy clay loam or clay topsoil and wetness class |

Brief Soil Profile Descriptions

| Worcester | Whimble |
|---|--|
| 0-20cm Ap Dark brown , slightly stony heavy clay loam or clay 20-50cm Bt(g) Reddish brown, stoneless clay or silty clay; strong coarse angular blocky structure 50-100cm BCt(g) Reddish brown, stoneless silty clay or clay; strong coarse prismatic structure 75-100cm BCtg Reddish brown mottled stoneless clay moderate coarse prismatic structure At 100cm Cr Reddish mudstone | 0-25cm Ap Dark brown slightly stony heavy clay loam 25-40cm Eb(g) Reddish brown, slightly mottled, slightly stony heavy clay loam; moderate medium subangular blocky structure 40-60cm Bt(g) Reddish brown, slightly mottled, slightly stony heavy clay loam; moderate to coarse prismatic structure 60-100cm 2BCtg Reddish brown, mottled, stoneless clay; Coarse prismatic structure At 100cm Cr Reddish mudstone |

Table 7: Table 7 Denchworth association (712b)

Slowly permeable clay soils and some similar soils with heavy clay loam topsoils. Waterlogged for long periods in winter.

| Main soil series | Ancillary soil series occurring locally | Geology | Average field capacity days (max 157 min 145) | Wetness class | Average moisture deficit and average and (available water) mm | | ALC grade | ALC determinants |
|------------------|---|--------------------------|---|---------------|---|-----------|-----------|--|
| | | | | | Wheat | Potatoes | | |
| Denchworth | | Mudstone | 151 | III-IV | 98 (>125) | 95 (>100) | 3b-4 | Clay topsoil and wetness. Grade 4 due to gradient on Windmill Hill |
| | Wickham | Thin drift over mudstone | 151 | III-IV | 98 (>125) | 88 (>100) | 3b | Heavy clay loam or clay topsoil and wetness. |

Brief Soil Profile Descriptions

| Denchworth | Wickham |
|---|---|
| 0-25cm Ap Dark greyish brown, mottled, slightly stony heavy clay loam or clay 25-65cm Bg Grey with many ochreous mottles, stoneless clay; weak medium angular blocky structure 65-100 BCg Grey, mottled, stoneless clay; weak coarse prismatic structure | 0-25cm Ap Dark greyish brown, mottled, slightly stony heavy clay loam 25-40cm Eg Greyish brown, mottled, slightly stony heavy clay loam; moderate coarse angular blocky structure 40-60cm 2Btg Grey, mottled, stoneless clay; moderate medium angular blocky structure 60-100cm BCg Grey with many ochreous mottles, stoneless clay: strong coarse prismatic structure |

Appendix AG-001-016 | Soils and agricultural land classification surveys

Table 8: Fladbury association (813b)

Clay soils waterlogged for long periods in winter.

| Main soil series | Ancillary soil series occurring locally | Geology | Average field capacity days (max 145 min 140) | Wetness class | Average moisture deficit (mm) | | ALC grade | ALC determinants |
|------------------|---|----------|--|------------------|-------------------------------|-----------|--------------|---------------------------------|
| | | | | | Wheat | Potatoes | | |
| Fladbury | | Alluvium | 143 | IV | 104 (>130) | 95 (>110) | 3b | Clay topsoil and wetness class. |
| | n/a | | | | | | | |

Brief Soil Profile Descriptions

| |
|--|
| Fladbury |
| 0-25cm Ap Dark greyish brown, mottled, stoneless clay |
| 25-65cm Bg Grey with many ochreous mottles, stoneless clay; strong coarse prismatic structure |
| 65-100 BCg Grey, mottled, stoneless clay; massive structure |

3 Forestry

3.1.1 Identification of forestry resources has primarily had regard to the National Forestry Inventory¹⁵.

3.1.2 The area of land under forestry (i.e. trees and woodland) within 2km either side of the route centre line has been determined using GIS and is shown in Table 9.

Table 9: Area of woodland within the study area and construction boundary

| | Area of forestry land (ha) | Forestry land as a % of total land area |
|--|----------------------------|---|
| Forestry land in study area | 273.1 | 5 |
| Forestry land within construction boundary | 7.7 | 3 |

3.1.3 Woodland in the south of the area is limited to sparse, small stands. In the north, woodland is a much more obvious feature of the landscape, and includes the Long Itchington and Ufton Woods. Woodland is relatively sparse over the area as a whole and represents 5% of land cover, compared to the national average of 10%. Therefore the sensitivity of the forestry land resource is high.

¹⁵ Forestry Commission (2001), *National Forest Inventory Woodland and Ancient Woodland (as updated)*.

4 Assessment of effects on holdings

- 4.1.1 The effects on holdings have been assessed according to the methodology set out in the SMR Addendum (Volume 5: Appendix CT-001-000/2). The nature of impacts considered comprises the temporary and permanent land required from the holding, the temporary and permanent severance of land, the permanent loss of key farm infrastructure and the imposition of disruptive effects (particularly noise and dust) on land uses and the holding's operations. These impacts occur primarily during the construction phase of the Proposed Scheme.

Table 10: Summary of assessment of effect on holdings

| Holding reference, name and description | Construction effects | Residual effects post restoration of land |
|--|---|--|
| CFA16/1 The Hall Farm 546.3ha of mainly arable and some livestock Medium sensitivity to change | Land required: 43.1ha; 8% of holding required for construction. Low Impact Severance: see notes under residual effects post restoration of land. Medium Impact Disruptive effects: no significant effects identified. Negligible Impact | Land required: 33.9ha; 6% of holding taken. Low Impact Severance: one parcel of land severed from the main holding. It will need to be accessed via public highway Medium Impact Infrastructure: includes provision of access off highway to severed parcel; reconnection of drainage. Low Impact |
| CFA16/2 New House Farm 50.6ha of mainly arable and some livestock Medium sensitivity to change | Land required: 2.9ha; 6% of holding required for construction. Low Impact Severance: none identified Negligible Impact Disruptive effects: no significant effects identified Low Impact | Land required: 0.6ha; 1% of holding taken. Negligible Impact Severance: none identified Negligible Impact Infrastructure: reinstatement of access track; restore function of drainage system Negligible Impact |
| CFA16/3 Stoneton Moat Farm 323.8ha of mainly arable and some livestock Medium sensitivity to change | Land required: 41.3ha; 13% of holding required for construction. Medium Impact Severance: two parcels of land severed from the main holding: Access provided under CoCP (see notes under residual effects post restoration of land). Low Impact Disruptive effects: Low Impact | Land required: 21.1ha; 7% of holding taken. Low Impact Severance: access to severed parcels of land provided by Footpath SM116a underpass (access over 3rd party) and access under Oxford Canal Viaduct. Both accesses are sized for agricultural vehicles. Low Impact Infrastructure: access provisions e.g. tracks, maintenance of drainage functionality and operation of water supply for stock watering troughs. Negligible Impact |

| Holding reference, name and description | Construction effects | Residual effects post restoration of land |
|---|--|--|
| <p>CFA16/4*</p> <p>Radbourne Grounds Farm</p> <p>175.7ha of mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 38.1ha; 22% of holding required for construction. High Impact</p> <p>Severance: western part of the farm severed from Lower Radbourne Farm buildings. Access provided under CoCP (see notes under residual effects post restoration of land). Low Impact</p> <p>Disruptive effects: none identified Low Impact</p> | <p>Land required: 31.9ha; 18% of holding taken. Medium Impact</p> <p>Severance: severance mitigated by Radbourne south viaduct and Radbourne Farm overbridge, both sized for agricultural access. Low Impact</p> <p>Infrastructure: access provisions; maintenance of drainage functionality and operation of water supply for stock watering troughs. Negligible Impact</p> |
| <p>CFA16/5</p> <p>Upper Radbourne Farm</p> <p>202.3ha of mixed arable and livestock</p> <p>Medium sensitivity to change</p> | <p>Land required: 15.0ha; 7% of holding required for construction. Low Impact</p> <p>Severance: large single field severed to the west of holding. Access provided under CoCP. Low Impact</p> <p>Disruptive effects: none identified Low Impact</p> | <p>Land required: 12.7ha; 6% of holding taken. Low Impact</p> <p>Severance: severance mitigated by Lower Radbourne Farm overbridge and Ladbroke Grove Farm overbridge. Low Impact</p> <p>Infrastructure: access provisions; maintenance of drainage functionality and operation of water supply for stock watering troughs; rationalisation of field boundaries; fencing. Negligible Impact</p> |
| <p>CFA16/6</p> <p>Hodnell Manor Farm</p> <p>283.3ha of mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 0.9ha; 0% of holding required for construction. Negligible Impact</p> <p>Severance: none. Negligible Impact</p> <p>Disruptive effects: none identified Negligible Impact</p> | <p>Land required: 0.4ha; 0% of holding taken. Negligible Impact</p> <p>Severance: none. Negligible Impact</p> <p>Infrastructure: field boundary reinstatement and maintenance of drainage functionality Negligible Impact</p> |
| <p>CFA16/7</p> <p>Ladbroke Grove Farm*</p> <p>82.0ha of mainly livestock (cattle and sheep)</p> <p>Medium sensitivity to change</p> | <p>Land required: 21.2ha; 26% of holding required for construction. High Impact</p> <p>Severance: western part of holding severed. Access provided under CoCP. Low Impact</p> <p>Disruptive effects: stock housed close to proposed construction area Medium Impact</p> | <p>Land required: 16.2ha; 20% of holding taken. Medium Impact</p> <p>Severance: western part of holding severed by HS2, Ladbroke Fox Covert and proposed planting. Severance mitigated by Ladbroke Grove Farm overbridge (sized for agricultural access) and other mitigation. Low Impact</p> <p>Infrastructure: maintenance of drainage functionality and operation of water supply for stock watering troughs. Negligible Impact</p> |
| <p>CFA16/8*</p> <p>Land north-east of Radbourne Lane</p> <p>29.1ha of grassland</p> <p>Medium sensitivity to change</p> | <p>Land required: 1.8ha; 6% of holding required for construction. Low Impact</p> <p>Severance: none Negligible Impact</p> <p>Disruptive effects: none identified Low Impact</p> | <p>Land required: 1.8ha; 6% of holding taken. Low Impact</p> <p>Severance: none Negligible Impact</p> <p>Infrastructure: maintenance of drainage functionality Negligible Impact</p> |

| Holding reference, name and description | Construction effects | Residual effects post restoration of land |
|---|---|---|
| <p>CFA16/9</p> <p>Ladbroke Hill Farm</p> <p>109.3ha of Mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 36.1ha; 33% of holding required for construction. High Impact</p> <p>Severance: two areas of land are severed. Access provided under CoCP. Low Impact</p> <p>Disruptive effects: none identified Negligible Impact</p> | <p>Land required: 34.7ha; 32% of holding taken. High Impact</p> <p>Severance: severance mitigated by Windmill Lane Farm overbridge and other mitigations Low Impact</p> <p>Infrastructure: access provision (surface tracks); maintenance of drainage functionality Low Impact</p> |
| <p>CFA16/10</p> <p>Land associated with Grounds Farm</p> <p>126.3ha of Mixed arable and livestock</p> <p>Medium sensitivity to change</p> | <p>Land required: 10.8ha; 9% of holding required for construction. Low Impact</p> <p>Severance: parcel of land severed to east of holding. Access provided under CoCP. Medium Impact</p> <p>Disruptive effects: none identified Low Impact</p> | <p>Land required: 5.5ha; 4% of holding taken. Negligible Impact</p> <p>Severance: parcel of land severed to east of holding will need to be accessed off Southam Road and via HS2 access track. Medium Impact</p> <p>Infrastructure: maintenance of drainage functionality and operation of water supply for stock watering troughs; fencing. Negligible Impact</p> |
| <p>CFA16/11</p> <p>Starbold Farm</p> <p>202.3ha of Mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 25.1ha; 12% of holding required for construction. Medium Impact</p> <p>Severance: area of land severed on outskirts of Southam that will need to be accessed off Southam Road. Medium Impact</p> <p>Disruptive effects: noise effects on diversified activities (e.g. residential and holiday lets) Medium Impact</p> | <p>Land required: 22.7ha; 11% of holding taken. Medium Impact</p> <p>Severance: area of land severed on outskirts of Southam, that will need to be accessed off Southam Road. Medium Impact</p> <p>Infrastructure: access provision (surface tracks); maintenance of drainage functionality Negligible Impact</p> |
| <p>CFA16/12</p> <p>Greenleaf Nursery</p> <p>2.2ha of horticulture – nursery</p> <p>High sensitivity to change</p> | <p>Land required: 2.2ha; 98% of holding required for construction. Holding becomes unviable as a result of this land requirement. High Impact</p> <p>Severance: none (see land required) Negligible Impact</p> <p>Disruptive effects: substantial High Impact</p> | <p>Land required: 1.6ha; 73% of holding taken. Holding becomes unviable as a result of this land requirement. High Impact</p> <p>Severance: none (see land required) Negligible Impact</p> <p>Infrastructure: loss of agricultural buildings including heated glass houses and cold-frames. High Impact</p> |
| <p>CFA16/13</p> <p>Brookend Farm</p> <p>98.3ha of mainly livestock (dairy)</p> <p>Medium sensitivity to change</p> | <p>Land required: 4.9ha; 5% of holding required for construction. Negligible Impact</p> <p>Severance: none identified Negligible Impact</p> <p>Disruptive effects: no significant effects identified Low Impact</p> | <p>Land required: 4.8ha; 5% of holding taken. Negligible Impact</p> <p>Severance: none identified Negligible Impact</p> <p>Infrastructure: maintenance of drainage functionality Negligible Impact</p> |

| Holding reference, name and description | Construction effects | Residual effects post restoration of land |
|---|---|--|
| <p>CFA16/14</p> <p>Wood Farm</p> <p>161.9ha of mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 29.1ha; 18% of holding required for construction. Medium Impact</p> <p>Severance: two blocks of land severed (one to NE of farm, the other south of Southam). All severed land is taken for construction activity. Negligible Impact</p> <p>Disruptive effects: noise impacts on diversified activities at Wood Farm including equestrian services. Medium Impact</p> | <p>Land required: 23.0ha; 14% of holding taken. Medium Impact</p> <p>Severance: severance of block NE of main farm buildings mitigated by access under Longhole Viaduct (with provision of suitable access track). Track also needed to provide access to severed land near Southam. Low Impact</p> <p>Infrastructure: access provisions; maintenance of drainage functionality and operation of water supply for stock watering troughs; fencing. Negligible Impact</p> |
| <p>CFA16/15*</p> <p>Folly Fields Farm</p> <p>17.2ha of mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 7.3ha; 43% of holding required for construction. High Impact</p> <p>Severance: no severance Negligible Impact</p> <p>Disruptive effects: none identified Low Impact</p> | <p>Land required: 6.7ha; 39% of holding taken. High Impact</p> <p>Severance: no severance Negligible Impact</p> <p>Infrastructure: maintenance of drainage functionality Negligible Impact</p> |
| <p>CFA16/16*</p> <p>Lower Farm</p> <p>32.7ha of mainly livestock (cattle and sheep)</p> <p>Medium sensitivity to change</p> | <p>Land required: 14.5ha; 44% of holding required for construction. High Impact</p> <p>Severance: no severance Negligible Impact</p> <p>Disruptive effects: none identified Low Impact</p> | <p>Land required: 13.8ha; 42% of holding taken, including area of ecological mitigation. High Impact</p> <p>Severance: none Negligible Impact</p> <p>Infrastructure: access provisions (through ecological mitigation area); operation of water supply for stock watering troughs; fencing. Negligible Impact</p> |
| <p>CFA16/17*</p> <p>Home Farm, Stoneythorpe</p> <p>88.3ha of mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 15.1ha; 17% of holding required for construction. Medium Impact</p> <p>Severance: none identified. Negligible Impact</p> <p>Disruptive effects: none identified Negligible Impact</p> | <p>Land required: 7.4ha; 8% of holding taken. Low Impact</p> <p>Severance: none identified Negligible Impact</p> <p>Infrastructure: maintenance of drainage functionality Negligible Impact</p> |
| <p>CFA16/18*</p> <p>Long Itchington Wood</p> <p>78.5ha of woodland</p> <p>Medium sensitivity to change</p> | <p>Land required: 0ha; 0% of holding required for construction. Negligible Impact</p> <p>Severance: none Negligible Impact</p> <p>Disruptive effects: none identified Negligible Impact</p> | <p>Land required: 0.0ha; 0% of holding taken. Negligible Impact</p> <p>Severance: none Negligible Impact</p> <p>Infrastructure: none Negligible Impact</p> |

| Holding reference, name and description | Construction effects | Residual effects post restoration of land |
|---|--|---|
| <p>CFA16/19*</p> <p>Land adjoining Woodmeadow Farm</p> <p>37.2ha of mainly arable</p> <p>Medium sensitivity to change</p> | <p>Land required: 11.9ha; 32% of holding required for construction.</p> <p>High Impact</p> <p>Severance: none</p> <p>Negligible Impact</p> <p>Disruptive effects: none identified</p> <p>Negligible Impact</p> | <p>Land required: 7.1ha; 19% of holding taken.</p> <p>Medium Impact</p> <p>Severance: none</p> <p>Negligible Impact</p> <p>Infrastructure: maintenance of drainage functionality</p> <p>Negligible Impact</p> |
| <p>CFA16/21</p> <p>Heath Farm</p> <p>2.4ha of equestrian (non-commercial)</p> <p>Low sensitivity to change</p> | <p>Land required: 0.0ha; 0% of holding required for construction (overlies Long Itchington Wood Tunnel).</p> <p>Negligible Impact</p> <p>Severance: none</p> <p>Negligible Impact</p> <p>Disruptive effects: none</p> <p>Negligible Impact</p> | <p>Land required: 0.0ha; 0% of holding taken (overlies Long Itchington Wood Tunnel).</p> <p>Negligible Impact</p> <p>Severance: none</p> <p>Negligible Impact</p> <p>Infrastructure: no impact</p> <p>Negligible Impact</p> |
| <p>CFA16/22*</p> <p>Stoneythorpe Estate</p> <p>7.8ha of mainly livestock (cattle and sheep)</p> <p>Medium sensitivity to change</p> | <p>Land required: 0.4ha; 5% of holding required for construction (overlies Long Itchington Wood Tunnel).</p> <p>Negligible Impact</p> <p>Severance: none</p> <p>Negligible Impact</p> <p>Disruptive effects: none</p> <p>Negligible Impact</p> | <p>Land required: 0.4ha; 5% of holding taken (overlies Long Itchington Wood Tunnel).</p> <p>Negligible Impact</p> <p>Severance: none</p> <p>Negligible Impact</p> <p>Infrastructure: no impact</p> <p>Negligible Impact</p> |

* No farm impact assessment interview conducted; data estimated.

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